

Appendix I. Population projections and trip forecasts with bridge

This appendix describes the approach used for projecting future population estimates under aviation and bridge scenarios, and estimating future vehicle and person trips that may occur annually between South Naknek and Naknek/ King Salmon under the bridge scenario.

A bridge across the Naknek River will provide road access to South Naknek and, compared to the existing situation of trips by aircraft and small boats across the river, increase the number of trips that residents of South Naknek make between Naknek and King Salmon, and the number of trips that residents of the latter two communities make to South Naknek.

Even after construction of this bridge crossing, the three communities will be isolated from other road systems in Alaska. The airport at King Salmon will provide the primary mode for passenger travel to and from other communities in the state and the Lower 48 states, and tugs and barges will be the primary mode for fuel and freight to and from the three communities. A bridge alternative will, however, increase the interaction between the communities by reducing the current cost of travel, whether expressed in terms of dollars (e.g., airfare between King Salmon and South Naknek), or time (e.g., boat crossing between Naknek and South Naknek).

The following sections of this appendix describe the results of a survey of Bristol Bay Borough residents to estimate the current number of trips across the Naknek River, and a methodology to estimate future trips.

Resident survey

The current number of trips between South Naknek and the other two communities in the Bristol Bay Borough is not well documented. Some limited information was found on air transport passenger and freight volumes, but data on travel by skiff, landing craft, tug and barge, automobile, or snowmachine across the river was nonexistent. As a result, a survey of Bristol Bay Borough residents was conducted to determine the number of trips made by local residents in 2003. No information was obtained on the number of trips made by fishers, other seasonal workers, and visitors to the community so the information presented in Table 1 underestimates the total number of trips. The estimate of more than 25,600 trips equates to about 71 trips per day.

Table 1. Roundtrips across the Naknek River by Bristol Bay Borough residents, 2003

Mode of travel	King Salmon	Naknek	South Naknek	Total
Air taxi	1,044	2,489	4,144	7,677
Private plane	3,169	2,774	249	6,192
Skiff or boat	1,683	5,354	2,063	9,100
Snowmachine	210	215	174	599
Other vehicle	921	106	1,046	2,073
Total	7,027	10,948	7,676	25,651

The survey provided information on current travel for local residents but the number of future trips was not estimated from survey data. Another methodology, described in the following section, was used.

Estimating travel demand with limited information

There are other communities around the state that are also isolated from connections to the national road system, where each community has an airport or air access (via floatplanes), and where there are road links between two or more of the communities. It was hypothesized that these types of communities have analogous situations where existing travel data could be used to project future travel between South Naknek and the other two Bristol Bay Borough communities once a bridge alternative is in place. Four relevant community-pairs were identified from around the state with annual average daily traffic count information. These community-pairs included:

Naknek – King Salmon

Craig – Klawock

Seldovia – Jakolof Bay

Nome – Teller

A concept often used in projecting vehicle trips and other forms of interactions between communities is the “gravity model.” Basically, the concept states that the number of interactions between the communities (e.g., vehicle trips or telephone calls) is a function of the level of attractiveness between the two communities (some factors may be negative and others may be positive), and the cost of that interaction. The size of the communities in terms of population or some other measure is often used as an indicator of attractiveness, and the cost of the interaction can be measured by a number of factors such as distance between the communities, the cost of vehicle travel between the communities, or the cost of a phone call. This basic approach is used in the following analysis to estimate future trips between the three Bristol Bay Borough communities, based on an equation developed from the four community-pairs.

Data for community-pairs

Table 2 shows the sum of 2003 population estimates for each community-pair, the average annual daily traffic (AADT) counts between each community-pair for 2003, and the mileage between each community-pair. Population data are from the Alaska Department of Labor and Workforce Development (ADOLWD) website, except for Jakolof Bay which is from the Alaska Department of Commerce, Community, and Economic Development website. Jakolof Bay population is not reported by ADOLWD. AADT estimates for 2003 are taken from the Annual Traffic Volume reports presented on the Alaska Department of Transportation and Public Facilities (ADOT&PF) website. The AADT counts were selected for a road segment near a mid-point between the community pairs with a goal of minimizing influence of local community travel on the traffic counts. Mileage estimates for the Northern and Central Regions are taken from the Annual Traffic Volume reports, while estimates for the Southeast community-pairs are based on the *Alaska Milepost*.

Table 2. Community-pair data

Community Pairs	Sum of Population	Travel Distance (miles)	Annual Average Daily Traffic
King Salmon – Naknek	999	15.5	1,010
Seldovia – Jakolof Bay	339	11.8	45
Nome – Teller	3,690	72.2	25
Craig – Klawock	2,025	6.2	2,060

Analysis

A multiple regression analysis using SPSS (Statistical Package for the Social Sciences) was employed to estimate AADT based on the population of the community-pair, and the distance between them.¹ The population and travel cost data for each community pair can be substituted into the equation and used to develop an estimate of the AADT that exists

¹ The equation derived from this analysis is:

$$\text{AADT} = 686.187784 + (0.858 * \text{Sum of Population}) - (52.051 * \text{Travel Distance})$$

$R^2 = .967$ (The R^2 indicates a strong correlation between the independent variables in the equation and the dependent variable of AADT.)

t statistic: Constant = 2.73; Population = 4.24; Travel Distance = -5.39 (The *t* statistic for each of the independent variables (constant, population, and travel distance) is greater than 2, which indicates that the variables are all statistically significant. Furthermore, for variables with a *t* statistic greater than 2, the larger the value of the *t* statistic (positive or negative), the stronger the influence of the variable on the results.)

The equation states that AADT is equal to a constant (686.188) plus the sum of the population for the community pair times a coefficient of 0.858 minus travel distance in miles times a coefficient of 52.051. The constant and the coefficients are estimated by the multiple regression analysis from the community pair data.

between the community pair. Since South Naknek will be interacting with both Naknek and King Salmon, the total population of the latter two communities was used along with a weighted average distance factor of 11.8 miles. The relative population of Naknek and King Salmon is used to adjust the 9.5 miles estimated distance between South Naknek and Naknek, and the estimated 15.5 miles distance between South Naknek and King Salmon.

Comparison of actual traffic levels with estimated traffic levels

The following table compares the actual AADT for the four community pairs with the estimated AADT from the equation, and the estimated AADT for trips between South Naknek and the other two Bristol Bay communities using the equation. If separate AADT estimates are developed for South Naknek-Naknek and South Naknek-King Salmon, the combined estimated AADT are approximately 100 trips greater than shown in Table 3.

Table 3. Actual and estimated average annual daily traffic

Community Pairs	AADT	Estimated AADT
King Salmon – Naknek	1,010	740
Seldovia – Jakolof Bay	45	350
Nome – Teller	25	105
Craig – Klawock	2,060	2,100
South Naknek – Naknek/King Salmon		1,020

A comparison of the actual AADT data with the estimated AADTs suggests that the equation may be an acceptable means for estimating future trips with a bridge alternative. The equation indicates that about 1,020 daily vehicle trips might occur in 2003 if a bridge were available between South Naknek and the other two communities, with the three communities having a total population of 1,101. Recall that in 2003, local residents indicated that they make about 71 round trips (142 one-way trips) per day with the existing situation.

There are several known factors that account for some of the variation between the actual AADT and the AADT estimated by the model. For example, the road links between Seldovia-Jakolof Bay, and Nome-Teller are gravel while the other road links are paved. Also, the Nome-Teller road is maintained only in the summer and is passable by passenger vehicles only during that time. If the roads were paved and maintained on a year-round basis the AADT on these two links would be higher. Since the Naknek River bridge and road connections would be paved and maintained year-round, the actual number of trips could be higher than estimated by the model, similar to the model estimating 740 trips between Naknek and King Salmon while the actual AADT is about 1,010.

The estimated AADT in Table 3 do not include any possible changes in economic conditions or population changes in South Naknek that might occur with a bridge. Such changes are addressed later in the memo. Table 3 shows the number of vehicle trips that would be expected if a bridge were in place with current economic conditions and population levels.

Changes in population with changes in regional economic conditions under the aviation scenarios

The level of traffic will change over time as the population changes so population forecasts are necessary to determine the future level of traffic. This section begins with a forecast of population estimates for the three communities and the Borough under the aviation scenarios. A subsequent section describes the potential changes that may be associated with a bridge across the Naknek River, and provides population forecasts that may be associated with the bridge scenarios.

Population changes will be driven to a large extent by economic opportunities surrounding the fishing industry. As noted in Appendix C, the salmon industry is in a state of flux, and it is difficult to foresee what the future will hold for the local seafood industry and residents. Given the difficulty in reliably forecasting future economic conditions, this study uses a scenario based approach to describe what the future might hold for the region. This scenario-based approach provides a wide range in which the likely future will be found, and enables the analyst to assess the viability of a project or its impacts within this range of futures. In developing these scenarios the consultant team reviewed statewide forecasts prepared by the Institute of Social and Economic Research at the University of Alaska Anchorage, the Alaska Department of Labor and Workforce Development, and studies prepared by Northern Economics on restructuring of the Bristol Bay Salmon Fishery, and other studies conducted by the firm in the region.

The population forecasts used in this study are predicated on changes in local economic conditions. The base case population forecast anticipates continuation of long-term trends described in Appendix C. The low case would see economic conditions deteriorate and the most negative population trends experienced over the past 13 years would be expected. Conversely, the high case would see economic conditions improve and the population would increase in response to those conditions. The turnabout in economic conditions is not expected to occur immediately so the current trends of decreasing population in King Salmon and Naknek would continue until about 2010 when economic conditions would have improved enough that population growth would begin.

These assumptions were converted into population trends expressed in terms of compound annual rates of change for each community. Table 4 shows the annual percentage change in population for the 2003 to 2033 period. The rates of change are constant over the time period for the low and base case. Under the high case King Salmon and South Naknek continue to lose population until 2010 when economic conditions improve.

Table 4. Population trends between 2003 to 2033 by community and scenario

Community	Low Case (%)	Base Case (%)	High Case (%)	
			2003-2009	2010-2033
King Salmon	-2.38	-2.02	-2.38	1.50
Naknek	0.04	1.03	2.16	2.16
South Naknek	-3.07	-1.57	-3.07	1.50

These scenario-derived trends in population were used to develop the population forecasts shown in the following figures. As noted in Figure 1 the communities of King Salmon and South Naknek continue to lose population under the base case, with many local residents moving to Naknek which is the center of the local government and the center of seafood industry employment. The closure of the active U.S. Air Force base in King Salmon in the mid-1990s is expected to result in continuing outmigration from the community as the local residents react to decreased employment opportunities. In South Naknek, the inability to create new jobs because of the higher costs associated with being on the south side of the river is expected to result in a continuation of outmigration from the community. The overall Borough population continues to decline under the base case scenario, albeit a relatively minor decline over the next 30 years.

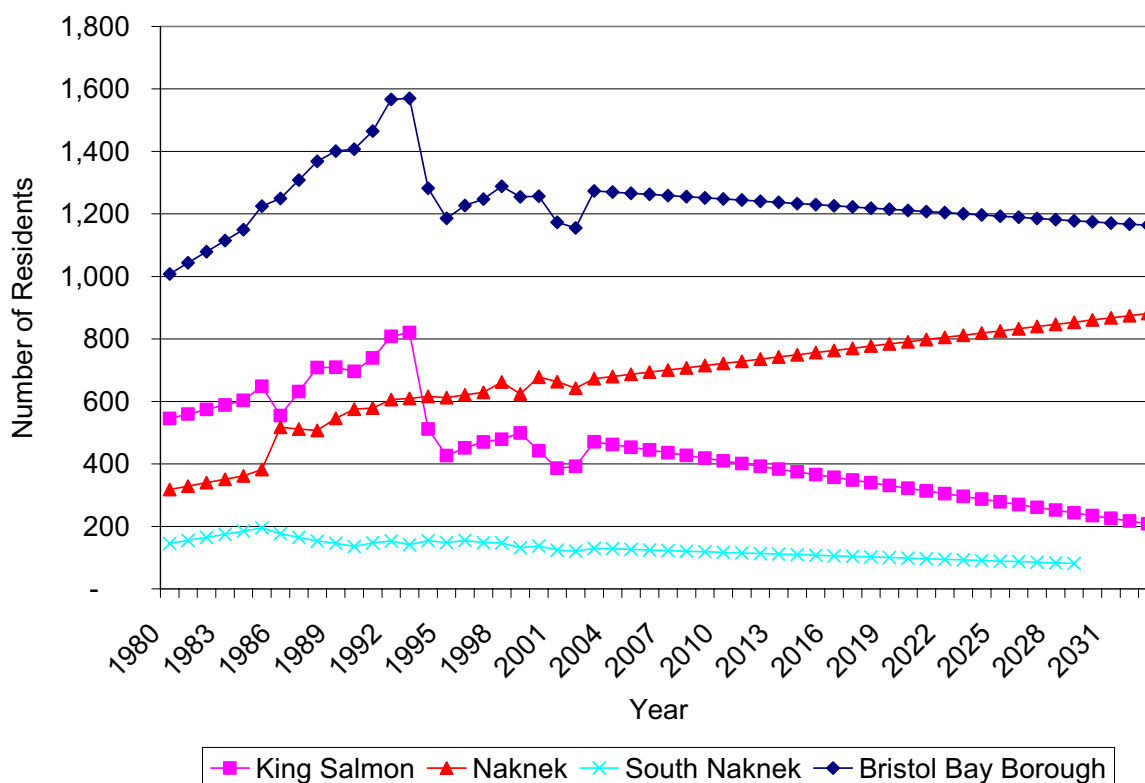


Figure 1. Base case population forecasts by community under aviation alternatives, 2003-2033

The low case scenario (See Figure 2) anticipates even greater losses in population for King Salmon and South Naknek, with Naknek hovering around its present population levels over the time period as poor economic conditions make it difficult for local businesses and residents. The result is a substantial population loss for the Bristol Bay Borough through 2033. It is not necessary in a scenario analysis to identify each potential event or activity and the resulting effect on the local economy, but rather to evaluate the difference from the base case provided by the low scenario assumptions. If the difference seems large enough that it will incorporate likely future conditions, it is sufficient for evaluation and sensitivity testing.

The high case assumes that economic conditions in the region improve (See Figure 3). This situation could occur due to improved statewide economic conditions such as a natural gas pipeline, continued high prices for oil, new oil and gas discoveries, or through improvements that more directly affect the local economy such as improved prices for salmon, oil and gas discoveries on the Alaska Peninsula, the beginning of large-scale mineral production in the region, and other possible events. As noted previously, population in King Salmon and South Naknek is assumed to continue declining at rates associated with the low scenario until 2009 when these future events result in improved economic conditions in the region.

Table 5 presents the actual population data for 2000 through 2002, and for 5-year intervals from 2010 through 2033, for each community under each scenario or case.

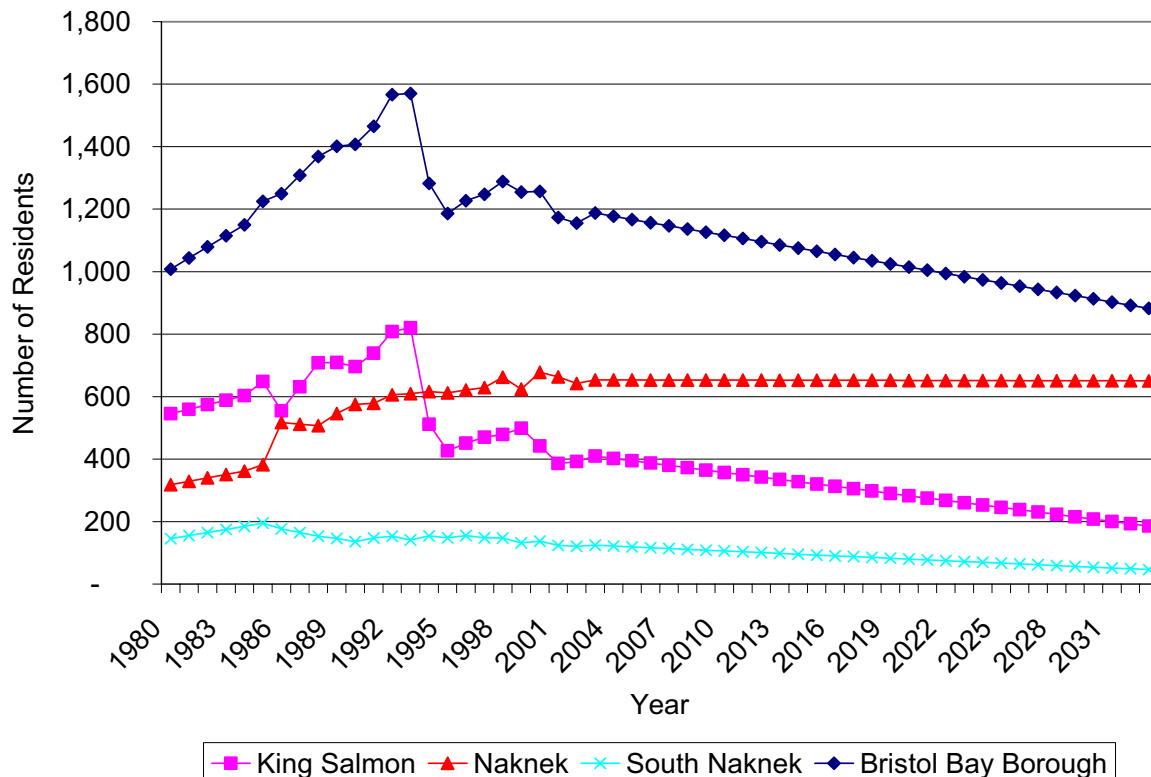


Figure 2. Low case population forecasts by community, 2003-2033

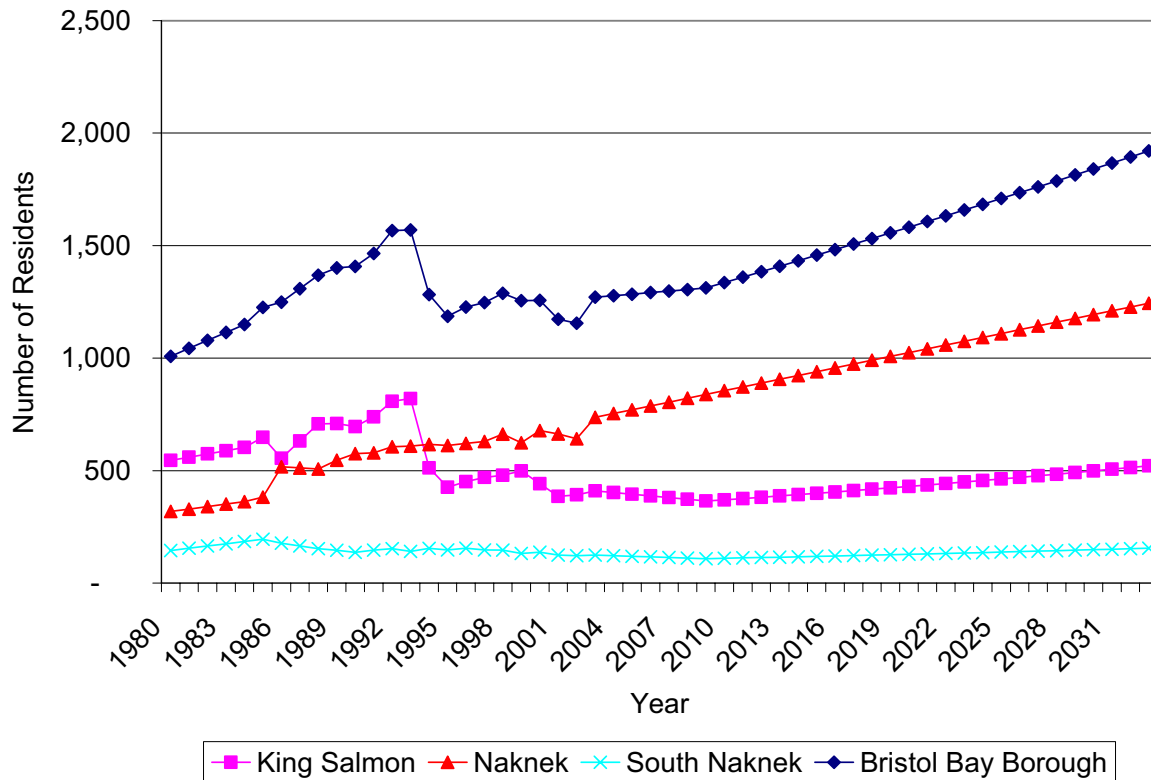


Figure 3. High case population forecasts by community, 2003-2033

Table 5. Population forecasts by community under aviation scenarios

Community	Year								
	2000	2001	2002	2010	2014	2019	2024	2029	2033
Base Case									
King Salmon	442	386	392	409	374	331	287	243	208
Naknek	678	663	642	722	749	784	819	853	881
South Naknek	137	124	121	117	109	100	91	82	74
Bristol Bay Borough	1,257	1,173	1,155	1,248	1,233	1,215	1,197	1,178	1,164
Low Case									
King Salmon	442	386	392	357	327	290	253	215	186
Naknek	678	663	642	653	652	652	651	651	651
South Naknek	137	124	121	106	96	83	70	57	46
Bristol Bay Borough	1,257	1,173	1,155	1,116	1,075	1,025	974	923	882
High Case									
King Salmon	442	386	392	370	393	423	456	491	521
Naknek	678	663	642	855	923	1,007	1,092	1,177	1,244
South Naknek	137	124	121	110	117	126	136	146	155
Bristol Bay Borough	1,257	1,173	1,155	1,336	1,433	1,557	1,684	1,814	1,921

Note: For comparison purposes, the ADOLWD projected that the Bristol Bay Borough population in 2018, the last year of their projection, would be 1,734 under the middle case, 1,413 under the low case, and 2,668 under the high case. These estimates are much higher than used in this report. ISER prepares statewide projections as well as projections for boroughs and census areas in the Railbelt, but projections for the Bristol Bay Borough were not found.

Economic and population changes resulting from the bridge alternative

The availability of a bridge would be expected to result in different economic conditions in the three communities, but particularly in South Naknek. The effect of the bridge on the communities is uncertain, so a range of outcomes is provided in this analysis, similar to those described under the aviation scenarios (See Table 6) using the low, base, and high cases.

Under the low case, it is assumed that the positive influence of the bridge is more than offset by the magnitude of adverse change in the regional economy. The decreasing population

trends in South Naknek and King Salmon continue and population levels are as projected in Table 5.

Under the base case, former residents of South Naknek who currently reside in Naknek because of the proximity to their current jobs return to the community, and the lower transportation costs result in economic growth and additional jobs in South Naknek. The overall population levels in the Bristol Bay Borough under the base case remain the same as shown in Table 5, but there is a shift in future population growth with a greater portion of future growth occurring in South Naknek. This shift begins with construction in 2012 and continues after the bridge opens in 2014.

Under the high case, positive changes in regional economic growth result in population growth in all three communities, and additional employment in the region. The positive economic changes could be associated with restructuring of the salmon fishery, oil and gas development on the Alaska Peninsula, completion of the road to Chignik, or a combination of these and other changes. Former residents of South Naknek return to the community and a significant portion of persons migrating into the region for economic opportunity also settle in South Naknek.

Table 6. Projected population with bridge alternative

Community	Year								
	2000	2001	2002	2010	2014	2019	2024	2029	2033
Base Case									
King Salmon	442	386	392	409	374	331	287	243	208
Naknek	678	663	642	715	735	759	783	808	827
South Naknek	137	124	121	128	135	143	152	161	168
Bristol Bay Borough	1,257	1,173	1,155	1,253	1,244	1,233	1,222	1,212	1,203
Low Case									
King Salmon	442	386	392	357	327	290	253	215	186
Naknek	678	663	642	653	652	652	651	651	651
South Naknek	137	124	121	106	96	83	70	57	46
Bristol Bay Borough	1,257	1,173	1,155	1,116	1,075	1,025	974	923	882
High Case									
King Salmon	442	386	392	397	416	442	470	500	526
Naknek	678	663	642	855	923	1,007	1,092	1,177	1,244
South Naknek	137	124	121	138	165	199	232	264	290
Bristol Bay Borough	1,257	1,173	1,155	1,390	1,504	1,648	1,794	1,941	2,060

Table 7 shows the projected AADT for passenger vehicles across the proposed Naknek River Bridge between South Naknek and the other two communities in the Bristol Bay Borough during the first 20 years of operation. The projected AADT uses the population forecasts for the communities presented above in Table 6. The other data in the equation are the same as those used to estimate AADT in Table 3.

Table 7. Projected average annual daily vehicle traffic across a Naknek river bridge

Scenario	Year				
	2014	2019	2024	2029	2033
Base Case	938	966	994	1,023	1,045
Low Case	498	441	383	326	280
High Case	945	1,105	1,265	1,427	1,557

The number of people traveling across the bridge can be estimated by multiplying the number of vehicle trips (AADT) by the average number of people in a vehicle (vehicle occupancy rate). An occupancy rate specific to the Naknek-King Salmon road is not available so a national average of 1.7 for all trips not in a metropolitan statistical area (Nationwide Personal Transportation Survey, 1990) was used to project the person-trip estimates shown in Table 8.

Table 8. Projected average annual daily person-trips across a Naknek river bridge

Scenario	Year				
	2014	2019	2024	2029	2033
Base Case	1,594	1,642	1,690	1,738	1,777
Low Case	846	749	652	554	476
High Case	1,607	1,878	2,151	2,426	2,647

